Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

of the division walls, such as M. Gayet seems to have considered superfluous, is very essential.

In studying M. Gayet's technique it is evident that he has depended too much upon rather primitive methods. While he has had recourse to various fixing and staining agents, he admits that so far as possible he has depended upon free-hand sections or "dissociation," *i. e.*, the dissection with needles of material treated with a strong macerating fluid. Where objects were too small to be thus handled they were imbedded in celloidin, which was then included in a coating of glycerine-soap. He does not appear to have employed paraffin for imbedding, nor to have employed any but nuclear stains, and it is very evident from some of his figures, *e. g.*, *5*, *83*, that cell-walls were in some instances entirely overlooked. In my own studies of the archegonium I have found such thin serial sections as can most readily be made by the paraffin method indispensable, and some good stain for the cell-walls, like Bismarck-brown, is necessary in order to differentiate the young cell-walls. The doubtfulness of conclusions drawn from a study of optical sections alone, from material rendered transparent by potash or other clearing agents, need not be insisted on here.

In short, until some of the statements made by M. Gayet can be confirmed by a thorough study of properly stained serial microtome sections, his conclusions can hardly be accepted without a certain amount of reservation.— DOUGLAS HOUGHTON CAMPBELL, *Leland Stanford Junior University.*

## THE HOMOLOGY OF THE BLEPHAROPLAST.

THE recent investigations upon plant spermatozoids have not only added immensely to our knowledge of the structure and development of these organisms, but have brought out interesting suggestions as to the homologies of certain structures.

Previous to 1894, writers were concerned largely in discussing whether the body of the spermatozoid consisted of nucleus alone, or of both nucleus and cytoplasm. All agreed that the cilia are developed from the plasma. Later contributors, Belajeff, Hirasé, Ikeno, Webber, Shaw and Fujii, have shown conclusively that the body of the mature spermatozoid consists of both nucleus and cytoplasm; and, further, all connect the formation of cilia with definite organs which are variously designated Höcker, Körnchen, Körperchen, Nebenkern, attraction sphere, directive sphere, centrosome, centrosome-like body, and blepharoplast. It may safely be assumed that the various writers would now agree that the body described under so many names is the same morphological structure in all the forms studied. In this sketch Webber's peculiarly appropriate term blepharoplast will be used, disregarding the terms used by the various writers.

In *Equisetum arvense*, according to Belajeff, there appears in the mother cell of the spermatozoid not only the cytoplasm and nucleus, but also a deeply staining body resembling a centrosome. This body stretches into a thread lying along the nucleus. The thread becomes differentiated into a row of granules (Höcker), each of which gives rise to a single cilium. In the fern, *Gymnogramme sulphurea*, in the cell which is to give rise to two spermatozoid mother cells, Belajeff figures two blepharoplasts at opposite poles of the nucleus, giving a very centrosome-like aspect, but the blepharoplasts do not divide like Guignard's centrosomes, and each spermatozoid mother cell receives but a single blepharoplast. The further history of the blepharoplast is essentially the same as in Equisetum. It is suggestive to note that in Chara there are two *Höcker*, each of which gives rise to a single cilium.

Shaw's figures of *Marsilea vestita* might lead one to infer that the blepharoplasts have some relation to nuclear division, their position at the poles giving them a very centrosome-like appearance; but we are assured that there is no ground for the assertion that blepharoplasts are homologous or analogous with the centrosomes of those plants which have centrosomes, and that whether they have any relation to the centrosomes of lower plants must be settled by an investigation of the spermatogenesis and zoospore formation of these plants. Shaw did not succeed in determining the origin of the cilia, but believed it to be as described by Belajeff for Equisetum.

The blepharoplasts of Gingko, Cycas, and Zamia are of gigantic size in comparison with those already mentioned. In these three forms, as in the cryptogams mentioned above, the blepharoplast stretches out into a band which gives rise to the cilia. Hirasé's figures and descriptions of Gingko show that the blepharoplast is surrounded by kinoplasmic radiations in nearly all stages of its history. Two blepharoplasts first appear at opposite poles of the nucleus of the body cell and during mitosis maintain a position at opposite poles of the spindle, although at some distance from the spindle and from the daughter nuclei after division has taken place. Judging from the figures, one might conclude that, while the blepharoplasts do not appear to be concerned in the formation of the spindle, they may perhaps determine its orientation. As a matter of fact, the wall between the daughter nuclei is at right angles to a line connecting the two blepharoplasts. Belajeff's figures of Gymnogramme and Shaw's of Marsilea show the same orientation. Hirasé believes that the blepharoplast is a centrosome.

Ikeno's description of blepharoplasts in *Cycas revoluta* agrees in general with Hirasé's account of Gingko. After reviewing Hermann's work on the spermatogenesis of the salamander and the mouse, Ikeno comes to the conclusion that the blepharoplasts of the Characeæ, Filicineæ and Equisetaceæ, and also those of Gingko, Cycas and Zamia, not only bear a superficial resemblance to centrosomes but are genuine centrosomes which become enormously elongated and furnish a place of attachment for the cilia. Belajeff had previously reached a somewhat similar conclusion, although it was left for Ikeno to formulate it. Belajeff homologizes the blepharoplast of Characeæ, Filicineæ and Equisetaceæ with the deeply staining body of the spermatid of the salamander and the mouse, while the middle piece of the animal spermatozoon corresponds to the elongated cilia-bearing band of the plant spermatozoid. The thread-like tail of the spermatozoon of the salamander and mouse corresponds to a single one of the cilia of the plant spermatozoid.

The blepharoplasts of *Zamia integrifolia* described by Webber are the largest yet discovered. Webber does not believe that they are centrosomes. It may be true that they take no part in the formation of the spindle, but an examination of the figures forcibly suggests that they either orient the spindle or are oriented by it.

The centrosome of the alga Dictyota, recently described by Mottier, becomes elongated into a band which gives rise to cilia-like radiations. Mottier, as will be remembered, declares that in the higher plants there are neither centrosomes nor centrospheres in vegetative or reproductive cells, whether in the resting condition or during division, and he further asserts that there are no bodies which have any resemblance whatever to these structures or which stand in any relation whatever to karyokinesis. In the paper on Dictyota, Mottier, referring to the blepharoplasts of higher plants, states that they have nothing to do with spindle formation, a more conservative statement which, though probable, still remains to be proved, and even if proved determines no homologies.

It is readily admitted that the presence of centrosomes is not established in any of these plants which have such conspicuous blepharoplasts, and that the blepharoplasts are reported only in the last two generations of cells concerned in the formation of the spermatozoid; but it must also be admitted that the usually spherical centrosome may in certain cases assume other shapes, and that an increasing number of competent observers do not regard the centrosome as a permanent organ of the cell. Furthermore, the absence of the centrosomes from the higher cryptogams and the flowering plants is far from being established, and a most convincing demonstration is necessary before the testimony of Guignard, Rosen, Campbell, Schaffner and others can be disregarded.

If our conception of the centrosome is formed exclusively from the familiar figures of karyokinesis and the function of the centrosome in this process, we shall doubtless look for a new name whenever we find a centrosome-like body performing any other function than that of the typical centrosome; but it seems probable that a thorough investigation of karyokinesis and the formation of cilia in the lower plants may support the theory that the blepharoplast is a centrosome. —CHAS. J. CHAMBERLAIN, *The University of Chicago.*

## BIBLIOGRAPHY.

BELAJEFF, WL.: Ueber Bau und Entwickelung der Spermatozoiden. Ber. d. deutsch bot. Gesell. **7** : 121–125. 1889.

——— — Ueber Bau und Entwickelung der Spermatozoiden der Pflanzen. Flora **79** : 1–48. 1894.

——— — Ueber den Nebenkern in spermatogenen Zellen und die Spermatogenesie bei den Farnkräuter. Ber. d. deutsch. bot. Gesell. **15** : 337–339. 1897.

——— — Ueber die Spermatogenesie bei den Schachtelhalmen. Ber. d. deutsch. bot. Gesell. **15** : 339–342. 1897.

——— — Ueber die Aehnlichkeit einiger Erscheinungen in der Spermatogenesis bei Thieren und Pflanzen. Ber. d. deutsch. bot. Gesell. **15** : 342–345. 1897.

GUIGNARD, L.: Dévelopment et constitution des antherozoides. Rev. gén. d. bot. **1** : 11–27, 63–78, 136–145, 173–194. 1889.

——— — Centrosomes in plants. Bot. Gaz. **25** : 158–164. 1898.

HERMANN, F.: Beiträge zur Kenntniss der Spermatogenesie. Archiv. f. mikr. Anat. **50** : 276–315. 1897.

HIRASÉ, S.: Notes on attraction sphere in the pollen cells of Ginkgo biloba. Bot. Magaz. Tokyo. **8** : —. 1894.

——— — Études sur la fécundation et l'embryogénie du Ginkgo biloba. (Second mémoire.) Jour. of the Coll. of Science, Tokyo. **12** : 103–149. 1898.

IKENO, S., and HIRASÉ, S.: Spermatozoids in gymnosperms. Ann. Bot. **11** : —. 1897.

IKENO, S.: Zur Kenntniss der sog. centrosomähnlichen Körpers in Pollenschlauch der Cycadeen. Flora **85** : 15–18. 1898.

MEVES, F.: Ueber Struktur u. Histogenesie der Samenfäden von Salamandra maculosa. Archiv. f. mik. Anat. **50** : 110–141. 1897.

MOTTIER, D. M.: Beiträge zur Kenntniss der Kerntheilung in den Pollenmutterzellen einiger Dikotylen und Monokotylen. Jahrb. f. wiss. Bot. **30** : 169–204. 1896.

SCHOTTLÄNDER, P.: Beiträge zur Kenntniss des Zellkerns u. der Sexualzellen bei Kryptogamen. Cohn's Beitr. z. Biol. d. Pflanzen **6** : 267–304. 1893.

SHAW, W. R.: Ueber die Blepharoplasten dei Onoclea und Marsilia. Ber. d. deutsch. bot. Gesell. **16** : 177–184. 1898.

——— — The fertilization of Onoclea. Ann. Bot. **12** : 261–285. 1898.

STRASBURGER, E.: Schwärmsporen, Gameten, pflanzliche Spermatozoiden u. das Wesen der Befruchtung. Histolog. Beitr. 4 : —. 1892.

WEBBER, H. J.: Peculiar structures occurring in the pollen tube of Zamia. Bot. Gaz. **23** : 453–459. 1897.

——— — The development of the antherozoids of Zamia. Bot. Gaz. **24** : 16–22. 1897.

——— — Notes on the fecundation of Zamia and the pollen tube apparatus of Ginkgo. Bot. Gaz. **24** : 225–235. 1897.